

PROGRESS AND PROBLEMS ESTIMATING CHINA'S COTTON SUPPLY AND DEMAND

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Abstract

USDA has developed a new approach for estimating cotton consumption in China, starting from textile import and export data, supplementing its traditional use of yarn production data from China's National Bureau of Statistics. In total, it appears that USDA's current estimates for China's cotton consumption are reasonable, although USDA's 2007 forecast may be conservative. These insights into the amount of cotton likely consumed by China's textile mills, combined with data on China's cotton exports and imports suggest there may be problems in the widely accepted official estimates of China's cotton production. The risk that unexpected changes in China's cotton import demand could destabilize world commodity markets continues despite increasingly open flows of information. This highlights the impact on world cotton markets of the lack of transparency in China's intervention in its domestic cotton markets and official cotton stock accumulation.

Introduction

The importance of China to the world cotton economy cannot be exaggerated. Unfortunately, the uncertainty regarding China's domestic cotton economy is also difficult to exaggerate. In recent years, China's import purchases have unexpectedly driven cotton prices sharply higher (October 2003), and during 2006 the unexpected withdrawal of China's import demand has weighed down on prices.

China's economy has moved significantly towards a reliance on market signals rather than government fiat in recent years. In addition, the openness of the economy to international influences has increased, and the secrecy with which the government treats economic data has been reduced. China and the rest of the world now exchange goods and information to an extent that would have been unthinkable even a few years ago, but the development of this exchange is incomplete. China's economy is substantially less open than the economies of other Asian developing and middle-income countries (as measured by the ratio of trade to gross domestic product). This is partly a function of China's size, but it is also a function of economic policy. Foreign investment flows into China with ease these days, and companies in China are beginning to invest elsewhere. However, the restrictions on capital movement from China are well known, as is the role China's government agencies play in the allocation of bank lending in China (Gale and Collender, 2006). Perhaps even more well-known is the government's role in determining the value of China's currency, rather than market forces. China has come a long way on the path to opening up channels for the exchange of capital, goods, and information. World cotton markets function more efficiently as a these changes have resulted in better, more timely

knowledge about cotton supply and demand in China, but the world still needs more information about China's cotton consumption, production, and stocks.

China's government does not provide estimates of mill use of cotton in China. Unofficial estimates from government agencies in China, and estimates by USDA, ICAC, Cotton Outlook, and others outside of China have traditionally been derived from reports of total yarn production provided by the National Bureau of Statistics (NBS). China's 2004 Economic Census revealed significant shortcomings in previous NBS yarn production reports, and the estimates of cotton's share of total yarn production have grown increasingly tenuous in recent years (Colby, 2006). These issues were recently ably surveyed in the ICAC's Review of the World Cotton Situation (Colby and Gruere, 2007). Because of these problems, USDA has developed an alternative approach of building an estimate of total mill consumption from two parts: an estimate of the mill use equivalence of the cotton contained in the textiles China exports, and an estimate of the volume of cotton textiles consumed by households in China.

This paper will estimate China's textile trade during 1999-2004 in terms of cotton fiber equivalents at the mill consumption level. These trade estimates will be used to derive estimates of China's domestic end-use consumption of cotton textile products. After establishing the historical levels of textile trade and domestic end-use consumption, this paper will address likely future developments in these variables, the impact of these developments on world cotton markets, and the issues surrounding the difficulty of estimating China's cotton supply and demand.

Estimating the Fiber Equivalence of Textile Trade

China is the world's largest textile exporter by a significant margin. According to the World Trade Organization (WTO), China accounted for 25 percent of the world's textile and clothing export value in 2005. The \$110 billion of textiles and clothing that China exported in 2005 contained millions of bales of cotton, and USDA has undertaken an effort to calculate this amount of cotton. While ultimately all estimates are at the mercy of the data used to develop them, and there are many questions concerning economic data from China, it is plausible that China's trade data are more reliable than some of the data on domestic economic activity. As China has opened its economy to outside influences, its trading partners have at times become concerned about the competition China's exports have offered on world markets. This has been particularly true for textiles, which was one of China's first growth sectors as China's economic reorientation began in 1978. The volume of China's textile trade has been an issue at the highest levels of government. China's trading partners have scrutinized data on textile imports from China quite extensively, providing incentives for China to maintain high standards in its textile trade reporting.

USDA has been estimating the raw-fiber quantity of U.S. textile imports and exports since 1960. For each product with a 10-digit code in the Harmonized Tariff Schedule of the United States (HTSUS), USDA has obtained information from contacts in the textile industry to develop factors for conversion from textile-product weight. These conversion factors were applied to China's trade, with some adjustments.

As an example, consider one specific group of women's sweaters (see Appendix for details). Lacking buttons or zippers, they are 100 percent comprised of fiber, and on average are 45 percent cotton. Therefore, 1 kilogram of sweaters includes 450 grams of cotton fiber. However, assuming that 3 percent of the cotton fiber used to spin the sweater's yarn is lost, and given further losses in knitting and assembling, a waste factor of 22 percent is applied. The result is a total of 549 grams as the cotton fiber-equivalent of 1 kilogram of sweaters. Finally, each sweater weighs 403 grams, on average. So, per sweater the cotton fiber-equivalent is $549 \text{ grams} \times 0.403 = 220 \text{ grams}$ (See Appendix for more details.).

USDA's calculations show that in 2006 China exported almost 41 million bales (fiber-equivalence) of cotton in the form of textiles, and imported a little more than 8 million bales. Therefore, about 32 million bales of the cotton spun in China's textile mills in 2006 was to supply the rest of the world with textile products.

Table 1--China's textile trade in cotton mill use equivalents, 2006

	Exports	Imports	Net Exports
	Million bales		
Yarn	2.7	4.4	-1.7
Fabric	11.1	3.1	8.0
Other	26.8	0.7	26.2
Total	40.7	8.2	32.5
	Percent increase		
Yarn	19	14	-6
Fabric	11	-2	17
Other	17	-8	18
Total	15	5	18

Source:ERS calculations based on data from China Customs.

Similar calculations have been undertaken by the International Cotton Advisory Committee/Food and Agriculture Organization (ICAC/FAO), and PCI Fibres, among others. Of these, the ICAC/FAO has published the most extensive discussion of its methodology, which is similar to USDA's, and its aggregate results are similar. While the USDA and FAO estimates for total net exports are virtually identical for 2004, USDA's estimated net exports were 825,000 bales higher on average over 2000-2005. USDA's estimates for clothing trade are typically lower than FAO's, but USDA's fabric trade estimates are typically higher than FAO's. PCI's 2004 estimate is lower than both USDA's and FAO's, but is close to some unpublished estimates.

Domestic Demand for Cotton Textiles in China

While China is the world's largest textile exporter, it also has the world's largest population, and is the world's second largest economy (after adjusting the exchange rate to account for low prices of services in China relative to the United States—at market exchange rates, China is the seventh largest economy). China is itself a significant consumer of textiles, and it is not uncommon for analysts to conclude that China's domestic demand for cotton textiles is greater than its export demand. Furthermore, overall demand for textiles in China is growing. Economic growth in China has in some recent years surpassed that of any other country, fueling consumers' demand there for textile products. NBS reported that real clothing expenditures in China rose 23

percent in 2005. However, increased clothing expenditures undoubtedly included increased value-added by retailers, and included purchases of products comprised of all fibers, and not just cotton. The measurement of household textile consumption is a difficult undertaking in any country. In China, these measurements are hampered by rapid structural change, gaps in the application of the rule of law, and a legacy of official secrecy.

This study will look at estimates of end-use of cotton textiles in China two ways. The first step will be the broadest, establishing a reasonable range for estimates of per-capita end-use of cotton in recent years. The second step will be to examine how end-use might be growing, and will specifically address the implications of this growth for estimated mill use of cotton in China in 2007/08.

Estimated Cotton End-use During 1999-2004

Traditionally, the household end-use consumption of cotton in China has been determined as a residual, the difference between total mill use and products exported, with the work by ICAC/FAO being the most well known example (Equation 1):

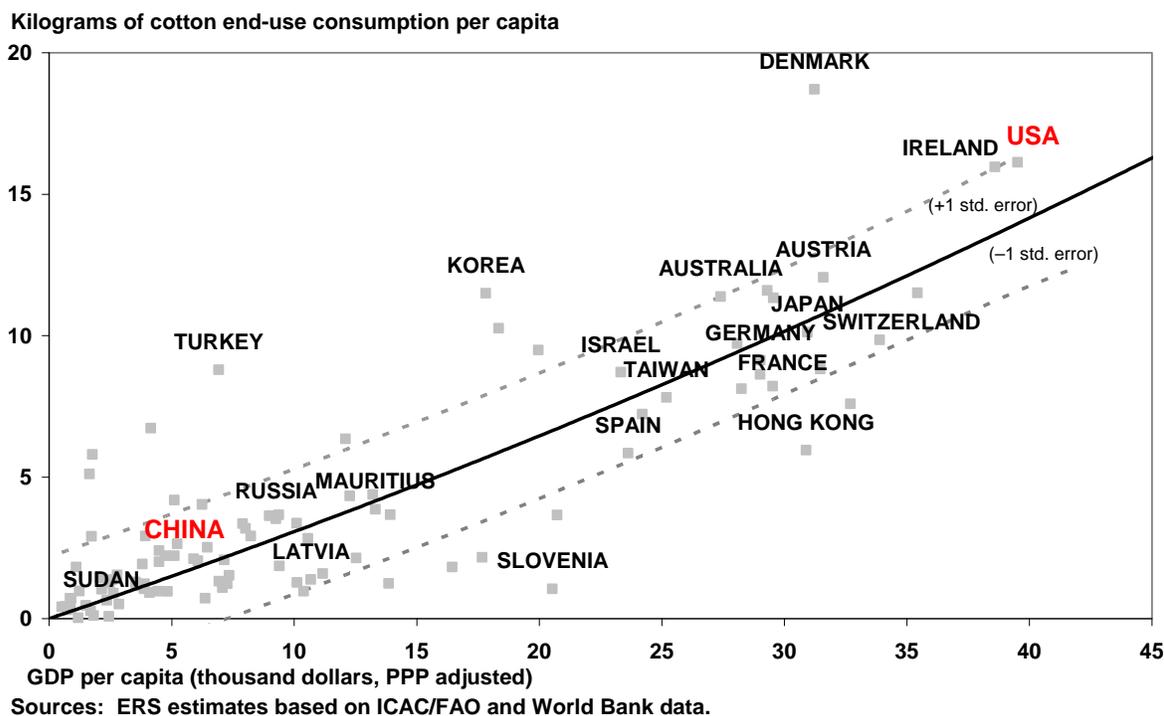
$$(1) \quad \begin{array}{l} \text{End-use consumption by} \\ \text{households in China} \end{array} = \begin{array}{l} \text{China's total} \\ \text{mill consumption} \end{array} - \begin{array}{l} \text{Fiber-equivalents} \\ \text{of textile net exports} \end{array}$$

Total mill use has been estimated using official government statistics of yarn production in China and a combination of official statistics and un-official estimates of the share that cotton accounted for in that yarn (Colby and Gruere). For a number of the years, the share number has been subject to a great deal of uncertainty, and in 2004, an economic census of the textile industry exposed significant errors in the statistics for total yarn production (Colby). Sources of error include the rapid growth in the industry, which has hindered the ability of the government to maintain up-to-date information necessary for accurate surveys. Another issue relates to the observation that any country with extensive government regulation is prone to the development of an underground economy. Corruption is acknowledged to be widespread in China, although not necessarily in the textile industry. Nonetheless, tax avoidance and other concerns are probably factors affecting the quality of the yarn production data. This in turn calls into question estimates of household end-use that are a function of the yarn-based consumption data.

If China published data on cotton stocks, assuming China's cotton production and trade statistics were reliable, the estimates of total China mill use could be checked as a residual from the rest of the balance sheet. Unfortunately, cotton stocks were long considered a state secret in China, and the legacy of this practice endures. While it is evidently no longer a crime to publish estimates of total cotton stocks in China, the size of the government's substantial stocks remains confidential.

As a result, while existing estimates of China's mill use of cotton have their shortcomings, they by necessity provide the initial basis for deriving an estimate of the consumption of cotton textile products by consumers in China. USDA's estimates during 1999-2004 were typically similar to those of ICAC and Cotlook, as well as estimates provided unofficially from China. On average, USDA's estimate ranged between the ICAC and Cotlook estimates. The maximum and

Figure 1--Income and cotton consumption by country, 2004



However, the large variability of per capita cotton consumption from country to country, even when income is taken into account, means a wide range of estimates for China are reasonable based on income level. Therefore, the difference between the reported 2.2 kilograms per capita and the 1.5 kilograms per capita implied by the average global relationship between income and cotton consumption is not important, nor is the difference between the 2.2 kilograms and the 3.1 kilograms estimated by PCI. PCI's estimate is also within one standard error of the regression-based estimate, which is the best benchmark USDA has developed to date. Further research is necessary to account for other factors, and determine if current estimates for China can be better corroborated with respect to expectations derived from fundamental economic principles.

This wide range also means that this analysis cannot rule out a much larger share for cotton in China's yarn production. Uncertainty regarding cotton's share of China's total yarn production is one of the draw-backs of the traditional estimates of China's cotton consumption. The last estimate published by China's government was 71 percent, in 1991. The conventional wisdom among officials, industry, and analysts in China is that the share is 64 percent. However, USDA and ICAC have been using lower estimates in recent years as China's importing and exporting of raw cotton has exposed inconsistencies in their supply and demand balance estimates for cotton. USDA's mill consumption estimates are currently based on the assumption that cotton's share of total yarn production in China is approaching 55 percent.

If USDA assumed a 64 percent share for MY 2006, cotton consumption would be estimated 7 million bales higher. Since this assumption has no bearing on the estimated level of exports,

estimated consumer end-use in China would bear the entire adjustment. In per capita terms, the end-use estimate would go from 2.5 kilograms to 3.6 kilograms. This would be a 45 percent increase, but would still be within one standard error of the 1.5 kilograms per capita derived from the international cross-sectional analysis. The fact that PCI Fibres estimates per capita consumption at 3.1 kilograms in 2004, and that China's economy has grown strongly since then, means that a higher estimate for 2006 is even more plausible.

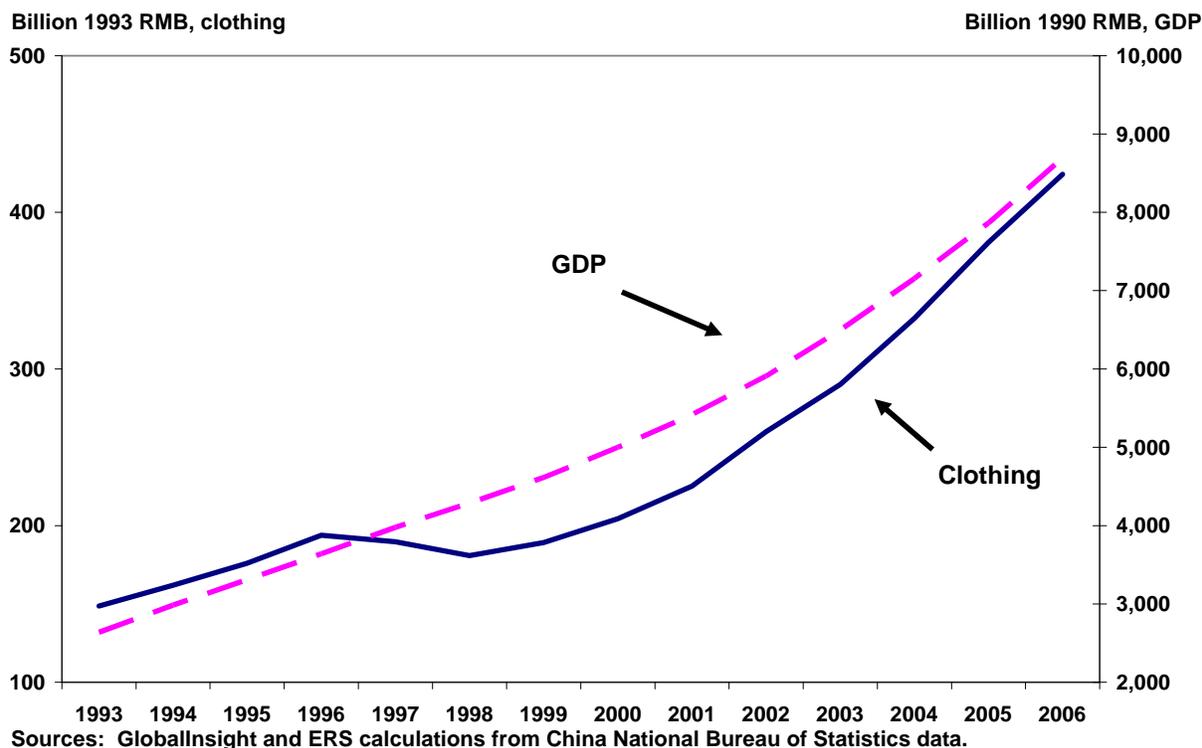
This analysis has established a broad initial range for per capita end-use of cotton textiles by China's consumers. While an average global relationship with income indicates that an estimate of 1.5 kilograms per capita would be appropriate for 2004, most analysis specific to China favors a higher estimated level of consumption. This suggests that around 2 kilograms per capita is a reasonable estimate as a 1999-2004 average. Given the rapid growth in China's economy, cotton end-use is probably growing. The following section will examine likely changes in end-use in recent years, examine the implications of growing end-use on China's cotton consumption, and the implications of growing cotton consumption for China's cotton imports.

Forecasting China's Domestic Cotton Textile Consumption

Rather than develop models for consumer end-use of all fibers in China and of cotton's share of these fibers, this study will address cotton consumption directly. In effect, income will be assumed to determine the net impact of both changes in total fiber demand and in cotton's share (see MacDonald, 2006a, for discussion of changes in shares of consumption by fiber).

Two income variables are applicable to cotton end-use consumption: real consumer expenditures on clothing (CEC), and GDP. China's economy is more investment driven than are more developed economies like the United States, and even developed economies find much of their GDP variation stemming from changes in investment. This adds to the intuitive appeal of using CEC as the variable to forecast cotton end-use. On the other hand, CEC is based on data from NBS, which is the source of the yarn production data that recently underwent such profound revisions. Concerns about NBS's yarn production estimates could just as well apply to its clothing expenditure estimates, and indeed, NBS's 2005 CEC estimate was a startling 23 percent higher than in 2004. Finally, CEC is available only on a lagged basis, while USDA contractors provide forecasts of China's GDP. Although China's GDP estimates have not been without controversy in recent years, this study will emphasize the cotton end-use estimates implied by GDP.

Figure 2-China: real clothing expenditure and GDP, 1993-2006



Estimates of China’s end-use of cotton were developed based on both CEC and GDP for comparison purposes. For additional comparison, past estimates were created to recreate the path end-use would have taken during 1999-2004 if it had been determined simply by CEC and GDP and achieved the same average as the implied USDA estimate over that time. Calendar year CEC-based estimates after 2005 are based on an estimated (1999-2005) expenditure elasticity with respect to income of 1.2. Calendar year GDP-based estimates are based on the assumption that the income elasticity of cotton end-use demand is 0.86 based on a previous USDA study (Seale, et al.). Estimates are made on a calendar year basis to correspond to the availability of macro-economic data, and weighted averages (lagged two months) are used for marketing years.

Table 3--China's cotton mill use for domestic consumption

	USDA Implied	Estimated: GDP-based	Estimated: Expenditure-based	Estimated: 64% share
	M. bales	M. bales	M. bales	M. bales
2004	13.9	14.5	16.0	17.6
2005	15.6	15.9	18.6	22.0
2006	15.1	17.3	20.4	25.4
2007	13.9	18.6	22.7	29.1

Sources: USDA and ERS calculations.

The GDP-based estimates start from a MY 2004 level about the same as USDA’s implied estimates, and the two grow at about the same rate in 2005. However, in 2006, USDA’s implied end-use consumption declines 8 percent. In contrast, China’s rapidly expanding economy drives

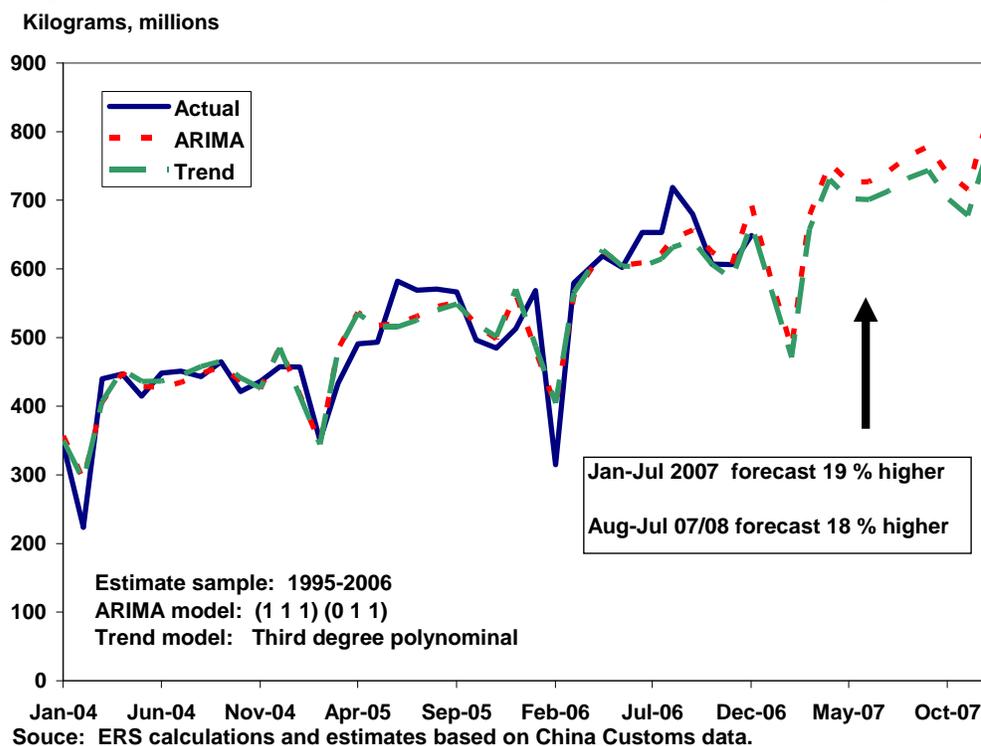
the GDP-based estimate up 9 percent. The pattern repeats itself in 2007, giving a 6.6-million-bale gap between the two estimates. The pattern is even more pronounced for the CEC-based estimates, with 9-million-bale gap in 2007. Finally, if China's total cotton mill consumption is estimated with the assumption that cotton's share of yarn production is fixed at 64 percent, China's 2007 end-use would be estimated to be more than twice the 13.9 million bales implied in USDA's 2007 mill use estimate. The reasoning behind USDA's conservative estimate will be examined after discussion of textile trade forecasting.

Trends in China's Textile Trade

In order to examine the implications of various end-use estimates on mill use, it is necessary to determine the amount of cotton that will have to be spun for exported textiles. This analysis will rely on two broad assumptions. The first assumption is that the methodology for converting textile trade into fiber-equivalents is valid. The second is that the trends observed in China's textile trade through December 2006 will continue to hold through July 2008. This latter assumption is supported by the economic and policy environment likely facing China's exporters between January 2007 and July 2008.

According to the WTO, world textile trade is growing rapidly, rising 8 percent annually on average between 1999 and 2005. However, during that time China's exports rose even more rapidly, at a 22 percent rate. China's share of world textile trade rose from 13 percent in 1999 to 24 percent in 2005. China's cotton textile trade on a fiber-equivalent basis has also grown rapidly in recent years, and exports have grown substantially faster than imports, resulting in a widening trade surplus. In 2001, the last year that China was not a member of the World Trade Organization (WTO), China exported 12 million bales of cotton textiles in net terms. Export growth accelerated with China's accession to the WTO, and again in 2005 after the elimination of the textile trade quotas established under the Multifibre Arrangement (MFA). By 2006, China's cotton textile net exports were 20 million bales higher, at 32 million bales. China's net exports grew between 17-20 percent in 2005 and 2006.

Figure 3--China net cotton textile exports: Jan 2004- July 2007



Forecasting China's exports in 2007 and 2008 involves consideration of a number of factors. World economic growth is expected to slow slightly from 2006's unusually strong level, the renminbi is appreciating 3-4 percent annually, and China recently made its value-added tax rebates for exporters less favorable. However, a Ministry of Commerce official in China recently indicated that China's textile exports are expected to grow 15-20 percent in 2007. China's NBS regularly reports on investment in China's textile industry, and investment during 2006 is supportive of continued growth in textile production faster than likely rates of domestic consumption during 2007. If the volume of net fiber-equivalent exports remain on the same trend as the last 10 years, 15-16 percent growth can be expected. More sophisticated time-series analysis (ARIMA modeling) of the data suggests 19 percent growth. These forecasts are not statistically different, so an unweighted average of the two was used.

Safeguards on China's textile exports applied by the EU are in effect through 2007, and those by the United States through 2008. Since these safeguards were present in 2005 and 2006 as well, this does not represent a change. The authority to utilize these safeguards expires at the end of 2008, per the provisions of China's 2001 WTO accession agreement (MacDonald and Vollrath). This suggests stability in the current policy environment for the coming year, supporting the theory that with continued favorable global economic growth it is reasonable to expect China to continue its current export pace.

If the average of the monthly forecasts produced by the 10-year trend and the ARIMA models are used to forecast monthly fiber-equivalent cotton net exports of textile products, and mill use is assumed to have occurred two months preceding shipment, then China would be expected to

consume 34.9 million bales of cotton in its textile mills for its textile exports in MY 2006. This would be 5.5 million bales, or 19 percent, more than in MY 2005. For MY 2007 the estimate would be 41.1 million bales, a 6.2 million bale, or 18 percent, increase. This would be more than double USDA's estimate of China's total consumption of cotton in MY 1999, and a 400 percent increase in net exports since that time.

Table 4--China's total cotton mill use (by domestic assumption and source)

	USDA	Estimated: GDP-based	Estimated: Expenditure-based	ICAC	Cotlook
	M. bales	M. bales	M. bales	M. bales	M. bales
2004	38.5	39.1	40.6	37.8	38.1
2005	45.0	45.3	48.0	44.2	43.2
2006	50.0	52.2	55.3	48.2	48.2
2007	55.0	59.7	63.8	50.2	50.5

Sources: USDA, ERS calculations, ICAC, and Cotlook.

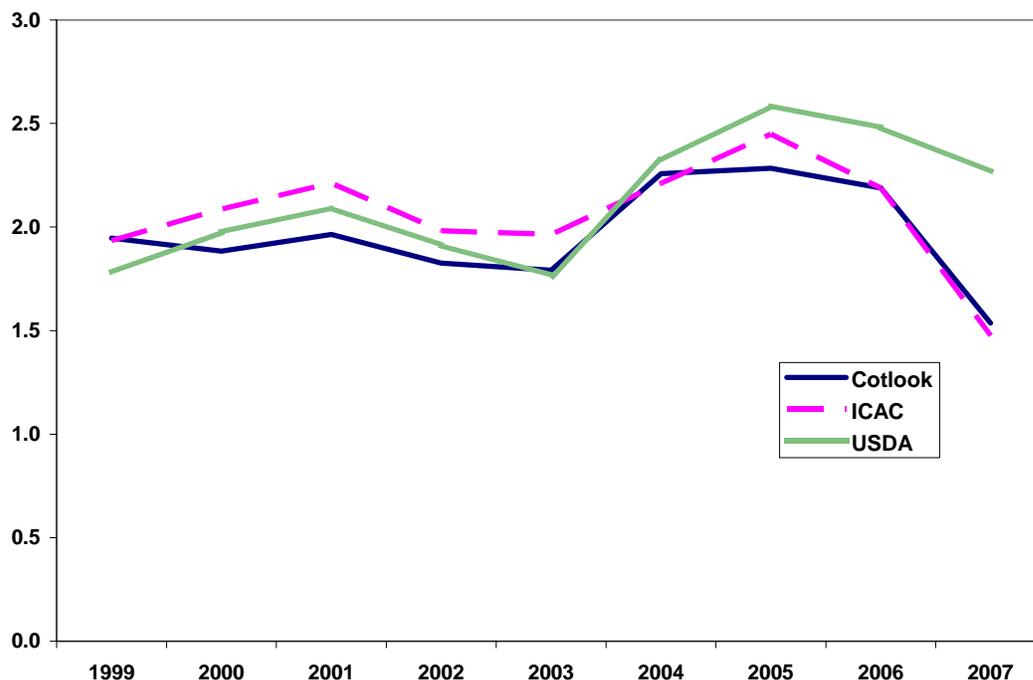
If the assumptions behind the 41-million-bale estimate of MY 2007 cotton textile net export fiber-equivalence are accepted, then China's MY 2007 total mill use estimate becomes a function of expected domestic cotton textile end-use. USDA's estimate of 55 million bales of mill use implies that end-use consumption of cotton textiles in China will fall to its 2004 level. The lowest alternative end-use estimate developed in this study (GDP-based) implies a level of 2007 mill use 5 million bales higher than USDA's estimate, or 60 million bales.

Conclusions and Implications

This exercise highlights the conservative nature of USDA's 2007 forecasts of China's cotton mill use. By this same measure, ICAC and Cotton Outlook's estimates of China's mill use seem even more conservative. Based in the analysis of China's textile trade, these estimates for mill use can be described as a forecast that consumers in China can be expected to purchase 30-33 percent less cotton textiles in MY 2007 compared with the year before. USDA's estimate implies a 9 percent decline. A comparison with the United States gives one pause: U. S. end-use of cotton has only declined once in the last 10 years—during 2001, when real GDP growth fell to its lowest in the last 15 years.

Figure 4--China's domestic end-use consumption of cotton textiles

Kilograms per capita (implied by mill use estimates)



Source: ERS calculations based on data from USDA, China Customs, ICAC, and Cotlook.

Caveats are always important in any China forecast. Recall again that these estimates of domestic cotton textile consumption do include inventory changes. China's economy is increasingly market-oriented, but the allocation of investment capital within China does still have a significant non-market component (Gale and Collendar). Given the vast uncertainties about developments within China—and the uncertainty and variability about textile end-use in any country—it is possible that end is falling. Possibly, changes in cotton's fiber share at the household level is keeping household end-use of cotton constant while changes in the availability in bank lending drive large swings in textile inventories, in turn driving apparent end-use upward and then down over 2003-2007.

Finally, the biggest caveat for any 2007 consumption forecast above 55 million bales is China's prolonged absence of a corresponding level of import demand from China. If China is going to consume 55 million bales of cotton in 2006 as the CEC-based estimate assumes, and produce about 31 million bales, as is widely expected, this implies a shortfall of 24 million bales. For 2007 the question is even more acute: the comparative shortfall would be 34 million bales. While it is difficult to rule out these very high estimates of China's cotton consumption on their own merits based on current knowledge, China has shown little sign of requiring such a volume of cotton from the rest of the world (MacDonald, 2006b).

But ultimately, we are left with the uncertainty that in the not too distant future, China's demand for cotton imports could differ millions of bales from the consensus of forecasts by USDA and others. The implications of such a shock for world cotton prices, households consuming textiles

around the world, and U.S. commodity programs would be significant. The continuing possibility of this shock is an uncertainty that imposes costs on the world's cotton sector, including China.

For several years, USDA responded to the growing inconsistencies in its estimates for China's cotton sector by adjusting consumption down. Conceivably, USDA could adjust its average implied end-use over 1999-2004 from 11.7 million bales to 8.1 million bales, corresponding to the difference between FAO's reported per capita end-use and the end-use estimated by the relationship with PPP-adjusted income. This would add a cumulative 22 million bales to stocks over the 6 year period, however, it would result in a domestically consumed portion of China's cotton consumption as low as 23 percent historically, and as low as 16 percent in 2007. This is wildly at variance with information from China that the majority of its cotton spinning is eventually consumed domestically. As noted earlier, it is also consistent with end-use estimates from a variety of sources.

More recently, USDA and ICAC have responded to the inexplicable gap between cotton production and consumption in China by including an adjustment in their balance sheets. This adjustment could conceivably represent errors of under estimation in production or in overestimates in consumption, on a net basis.

USDA's China consumption estimates for other commodities have been reduced in past years as well, but there has been no adjustment in the production estimates. The underreporting of planted area in China was widely known before the 1997 agricultural census, which confirmed it. However, the 1997 Census did not indicate errors in China's official cotton production estimates. Periodically, estimates at variance with the official estimates have circulated and received varying degrees of credence. But in the last year some of the alternative proposals for estimated cotton production in China have been more concrete. In particular there has been a focus on alleged underreporting of production from Xinjiang. A series of Xinjiang-specific policy initiatives from China in the last 2 years aimed at addressing a perceived excess of supplies have been consistent with a large and growing output in the region.

It is difficult to reconcile the large surge in imports during 2005/06 combined with the current virtual absence of buying with a long-standing significant overestimation of consumption and overestimation of stocks. It is also difficult to reconcile the large surge in China's reported yarn production with an assumption that China's industrial consumption of cotton has not grown significantly.

The Importance of Information about China's Cotton Sector

World cotton markets are most interested in China's likely demand for imports of raw cotton. Trends in China's textile exports, and their impact on cotton spinning outside of China, are relatively well established, although that could change one day. China has a long-standing system for publishing production estimates. China's economy is also sufficiently open that informed discussion is possible concerning the validity of those estimates, particularly those for Xinjiang. China also has a long-standing system for publishing yarn production data, and information about cotton yarn. Hopefully, the issues revealed by the 2004 Economic Census can

be addressed, and more light can be shed on the perennial question of the cotton share of China's yarn production.

Information on the level of stocks in China needs additional breadth and depth. Surveys of industrial stocks and commercial stocks are increasingly available from non-government sources. The reform of China's cotton sector starting in 1999 involved a shift from micro-economic control of economic decision-making to a policy of "macro-control," in part implemented through the acquisition and disposal of cotton stocks. Government stock-holding is a not uncommon policy instrument in countries around the world. Secrecy regarding the level of these stocks is less common. When a country consumes 40 percent of the world's cotton, withholding such information can have a significant impact on world markets.

Transparency is one of the principles guiding the multilateral efforts to develop the international trading system over the last several decades. Hopefully, through research, and continued increases in the availability of economic information, the world can gain a better understanding of China's cotton sector, and avoid the disruption of unexpected, large changes in China's import demand.

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References

Colby, Hunter. "Revisions to the China Balance Sheet," *Cotton and Wool Outlook*, U.S. Dept. Agr., Economic Research Service, CWS-06a, February 2006.

<http://usda.mannlib.cornell.edu/usda/ers/CWS//2000s/2006/CWS-02-10-2006.pdf>

Colby, Hunter, and Armelle Gruere. "Estimation of Cotton Consumption in China (Mainland) Based on Yarn Production Statistics," *Cotton: Review of the World Situation*, 60(3): 5-9, 2007.

Gale, Fred, and Robert Collender. *New Directions in China's Agricultural Lending*, U.S. Dept. Agr., Economic Research Service, WRS-06-01, January 2006.

<http://www.ers.usda.gov/publications/WRS0601/WRS0601.pdf>

International Cotton Advisory Committee/Food and Agriculture Organization (2006), *World Apparel Fiber Consumption Survey*, Washington, DC.

Lawler, John V, and Mae D. Johnson (1992), "U.S. Textile Imports and Exports," *Cotton and Wool Situation and Outlook*, U.S. Dept. Agr., Economic Research Service, CWS-97: 21-103. February 1992.

MacDonald, Stephen. "Factors Driving World Cotton Consumption," *Cotton and Wool Outlook*, U.S. Dept. Agr., Economic Research Service, CWS-06h, Sept. 2006a
<http://usda.mannlib.cornell.edu/usda/ers/CWS//2000s/2006/CWS-09-13-2006.pdf>

MacDonald, Stephen. "Early-season Indicators Point to lower China Imports," *Cotton and Wool Outlook*, U.S. Dept. Agr., Economic Research Service, CWS-06h, Oct. 2006b
<http://usda.mannlib.cornell.edu/usda/ers/CWS//2000s/2006/CWS-10-13-2006.pdf>

MacDonald, Stephen, and Thomas Vollrath. *The Forces Shaping World Cotton Consumption After the Multifibre Arrangement*, U.S. Dept. Agr., Economic Research Service, CWS-05c-01, April 2005.
http://usda.mannlib.cornell.edu/usda/ers/CWS//2000s/2005/CWS-04-15-2005_Special_Report.pdf

PCI Fibres. *World Synthetic Fibres: Supply and Demand Report*, West Sussex, UK, 2005.

Seale, James, Regmi, Anita, and Jason Bernstein. *International Evidence on Food Consumption Patterns*, U.S. Dept. Agr., Economic Research Service, Technical Bulletin Number 1904, October 2003.
<http://www.ers.usda.gov/publications/tb1904/tb1904.pdf>

Appendix: Calculating fiber-equivalents

USDA has been estimating the raw-fiber quantity of U.S. textile imports and exports since 1960 (Lawler and Johnson). For each product with a 10-digit code in the Harmonized Tariff Schedule of the United States (HTSUS), USDA has obtained information from contacts in the textile industry to develop factors for conversion from textile-product weight. For each product, USDA determined:

1. fiber's share of the product's weight,
2. cotton's share of the product's fiber content,
3. waste resulting from yarn manufacture,
4. waste from trimming during weaving and knitting fabric, and
5. cutting loss in apparel and other finished product operations.

This information is combined to create a conversion factor for estimating the quantity of raw fiber needed to make the various textile products, beginning with the bales of raw fiber opened at the mill. There are about 7,000 import conversion factors and about 2,000 export conversion factors, and the last extensive revision of these factors occurred in 2001.

Existing U.S. import conversion factors were used to develop conversion factors for China's exports and imports. Developing an entirely new set of conversion factors was not feasible, and, plausibly, the conversion factors for China's largest market for textile exports are a good estimate of the factors that apply to China's trade. The U.S. conversion factors were first converted to trade-weighted averages at the 6-digit HTSUS level to ensure product concordance with China's trade data. By averaging to the internationally harmonized product level, and focusing only on products that contain cotton, the number of conversion factors was reduced to 569.

The immediate source of the import and export data from China used in this analysis is the Global Trade Information Service (GTIS), which publishes data from China Customs. The GTIS's World Trade Atlas reports some data in kilograms and other data in non-weight units, such as meters and square-meters for fabric and pieces or numbers for clothing. China reports most of its trade in both kilograms and these other units, but GTIS distributes only the non-kilogram data for a large number of products. But, GTIS data is available monthly back to 1995 and is updated each month. This makes GTIS an appropriate source despite the need to develop additional conversion factors. Conversion factors into kilograms were developed using data published by China's National Bureau of Statistics (NBS) at the 8-digit level, supplemented with data on U.S. imports for products which China does not report in kilograms. The 6-digit conversion factors are trade-weighted averages.

Continuing the example of sweaters developed above, China's trade data shows that for HS 61109090, each article weighs 403 grams. Given the example above, each sweater would have $0.4 * 450$ grams, or 180 grams, of cotton at the textile product level. The amount of fiber consumed by textile mills to produce this would be $1.22 * 180$ grams, or 220 grams. Note that the 6-digit HS 611090 includes a number of other products in addition to 61109090, and on average each sweater has a cotton fiber-equivalence of only 70 grams.

Appendix table 1--China's 2006 textile exports in cotton fiber-equivalence

HS Code	Description	Cotton	Exports	Fiber-equivalence
		per piece	in 2006	of 2006 exports
		Kilograms	Number	480lb bales
611090	SWEATERS, NESOI	0.07	265,190,652	79,290
610342	M/B TROUSERS OVERALLS :	0.32	96,796,759	144,376
620520	MEN'S OR BOYS' SHIRTS	0.35	235,567,309	374,729
.....				
(566 other products, including yarn reported in kilograms and fabric reported in meters)				
.....				
--	Yarn	--	--	2,694,228
--	Fabric	--	--	11,112,087
--	Clothing and other products	--	--	26,759,370
--	Total	--	--	40,565,685

Source: ERS calculations based on PRC Customs Service data.

Fiber-equivalence estimates can differ for a variety of reasons. Variation in product coverage is one reason. Textiles are included in a very large number of products, and resource constraints

often dictate that researchers limit their data acquisition and analytical efforts, with different studies selecting different products on the margin. Another reason is differences in conversion factors. Again, the information requirements are enormous, especially for studies involving large numbers of countries over long spans of time. Some studies use standardized conversion factors for some groups of products, while others emphasize product detail. Waste factors can also vary, with some China-specific research indicating that cotton spinning in China has a smaller amount of waste than embodied in USDA's estimates for the United States. In this study, estimated spinning waste was adjusted downwards to concord with the historical estimates USDA and others have been using in the conversion of NBS yarn production data into estimated cotton consumption.

Finally, China reports significant imports of textiles from itself, and the treatment of this trade can affect estimates of total trade. In 2006, 15 percent by value of China's textile imports were themselves reportedly from China. China has extensive export processing zones, and differing tariff and tax treatment depending on whether the output of plants is intended for consumption within China or for export elsewhere. Possibly, these imports from China are from export processing zones or from firms legally obliged to export. Keeping these imports in an estimate of China's total imports may skew calculations of net exports or end-use demand if these "imports" are goods that actually were already located in China. Alternatively, these imports could be from bonded warehouses, with unknown original sources. Or, they could be products that were initially recorded as exports to other destinations for tax purposes, but actually only traveled short distances on coastal shipping, and are acknowledged as having been sourced in China. Currently, USDA does not adjust its trade data to account for imports from China, relying on the total figures for imports from all destinations supplied by China Customs for its calculations.